Summary of Findings: CORMIX Modeling of City of Sandpoint Discharge

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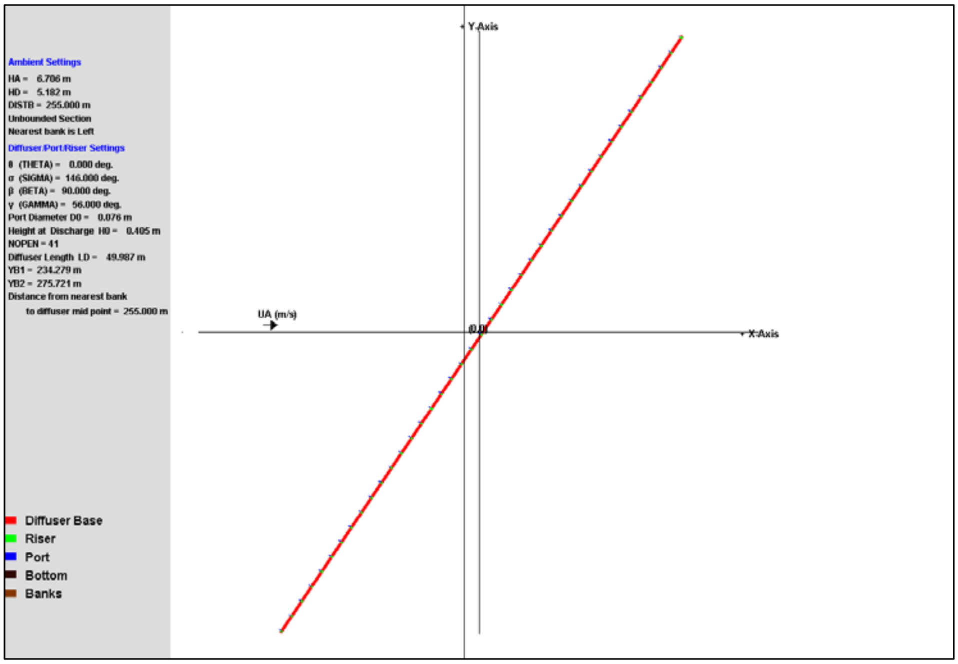
1 Overview

- The river at the Sandpoint WWTP is very wide (9600ft), so the model was run as an unbounded channel.
- The velocity used in the model was 0.2 ft/s, which was the low end of the ambient velocity measured by Bob Steed on 8/3/15. The direction at the surface was north 18° east (18° "clockwise" from true north). The direction at 80% depth was undetermined.
- Under these conditions, the ambient velocity would push the plume toward the shore and then toward the spit at the north end of the "long bridge."
- Using the map of the outfall provided with the application, I estimate the angle of the diffuser axis relative to the current (Cormix calls this angle GAMMA) at 56°, and the angle of the ports relative to the current (SIGMA) at 146°. Since the angle of the ports relative to the current is greater than 90°, the ambient velocity opposes the momentum of the discharge. Cormix will run with this geometry *only if* the "Override Warnings" option is selected from the "Pre-Processing Tools" menu. This diffuser configuration is shown in Figure 1, below. Note that the ambient velocity (UA) is parallel to the x-axis.
- Temperature data collected by DEQ in 2005 indicate a maximum of 0.8 °C of overall temperature stratification from the surface of the river to the bottom, with a median of zero. Both stratified and uniform ambient temperature scenarios were run, using actual temperature data for a particular date and time.
- Dilution factors have been calculated for the acute and chronic mixing zones. This is the volume of water that must mix with the effluent before it meets either the acute or chronic criteria. In this case these factors are acute 48:1 and chronic 77:1. These dilutions are used in combination with the critical flows to determine the final mixing zone size. Critical flows vary by pollutant, for example, ammonia uses the 1Q10 flow; mercury and chlorine use the 7Q10 flow.
- The dilution isolines shown in Figures 2 and 3 outline the modeled size and shape of the effluent plume during two conditions: (1) when the temperature of the river water at the diffuser is uniform in temperature from top to bottom; and (2) there is a difference of 0.8°C temperature from top to bottom. The difference in water density created by second scenario shows a significant positive effect on mixing; however, river temperature profile data show that a uniform temperature from top to bottom is typical during summer months.
- Results shown in Figure 2 indicate that the cold water aquatic life chronic ammonia plume extends 440 meters before it meets criteria yet the shoreline is only 281 meters from the end of the diffuser. The exact plume shape once it hits the shoreline cannot be predicted without more information. Ammonia has no human health criteria.

Commented [JuneB1]: Brian, as you can tell I am not sure how you go from dilution factor to get MZ when MZ size is needed to calculate the DF. Did you assume some MZ size to calculate your DFs?

Figure 1: CorSpy view of diffuser from top down (I'm not sure what this graph is telling me)



2 Results

2.1 Uniform Ambient Density

- Dilution at 200m downstream (shore): 77:1
- Dilution after 900 seconds (15 minutes) of plume travel[1]: 48:1
- Note that the chronic dilution factor of 77:1 is equivalent to a 7.3% MZ for ammonia using the 1Q10 critical flow; a 15% MZ for mercury using the 7Q10 critical flow; and a 15% MZ for chlorine using the 7Q10 flow.

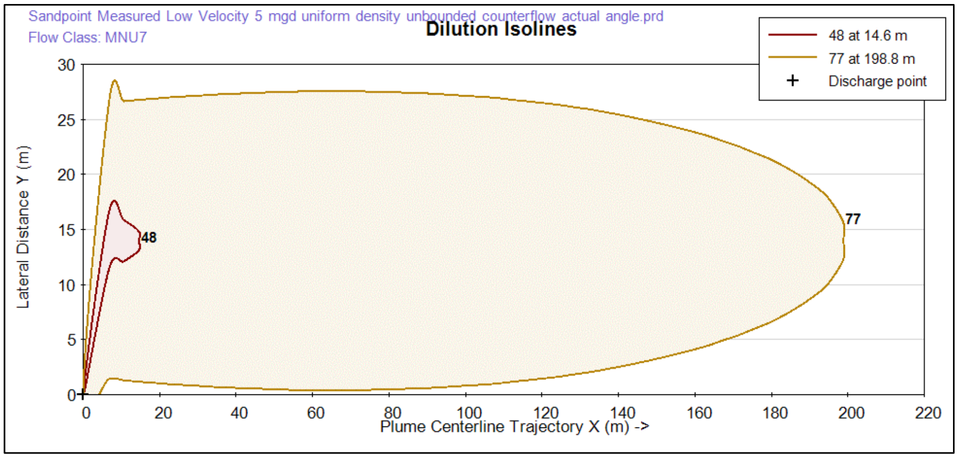
2.1.1 Parameter-Specific Results

The model predicts poorer mixing with uniform ambient density than with stratified ambient density (see section 2.2, below). Thus, the uniform ambient density model was used for further investigation of the mixing zones for specific parameters, using the maximum projected effluent concentration, which is generally the maximum measured concentration multiplied by the reasonable potential multiplier. The results are as follows:

[1] This is an acceptable option for sizing the acute mixing zone. See the *Technical Support Document for Water Quality-based Toxics Control* at Sections 2.2.2 and 4.3.2.

- "Downstream" distance[2] to meet ammonia criteria:
    - Acute: 6.7m
    - Chronic: 440m
- "Downstream" distance to meet chlorine criteria (using the maximum daily effluent limit from the prior permit):
    - Acute: 93m
    - Chronic: 293m
- "Downstream" distance to meet mercury criteria:
    - Acute: 0 meters (discharge meets the acute criterion at the end of pipe)
    - Chronic: 660m

Figure 2: Dilution isolines for uniform ambient density run



2.2 Stratified Ambient Density

- Dilution at 200 m downstream (shore, chronic MZ): 254:1
- Dilution after 900 seconds (15 minutes) of plume travel (acute MZ): 220:1

[2] Because Cormix is not "aware" of the boundary created by the shore, which is downwind of the discharge, model predictions at distances greater than about 200 meters may not be accurate. However, a predicted distance greater than 200 meters does mean that the water quality criterion will **not** be met at the point where the plume meets the shore, under the conditions specified in the model.

Figure 3: Dilution isolines for stratified ambient density run